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Bacillus thuringiensis Field Tested Against Western Hemlock Looper [1/]

by

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The western hemlock looper periodically causes severe damage in coastal forests of Oregon, Washington, and British Columbia. Heavy feeding by this insect can kill hemlock trees in one year. Because outbreaks develop rapidly, direct control is usually needed the year after discovery of tree damage to prevent wholesale destruction of valuable timber. Aerial spraying with DDT in oil was proven in 1945 to be an effective control measure. In 1962 it was again used against the hemlock looper in northwest Oregon.

Potential hazard of DDT spraying to other resources in coastal areas -- salmon, oysters, clams, and dairying -- has led to increasing caution in the use of this insecticide and a search for alternative control measures. Various substitutes and modification in spraying methods have been proposed. In 1963, in connection with a looper control project in southwest Washington, considerable field testing using helicopters was done by the U. S. Forest Service to compare the usefulness of other materials with DDT.

One material tested was the microbial insecticide, *Bacillus thuringiensis* Berliner. Laboratory tests at our Forestry Sciences Laboratory in 1962 showed the commercial product, Thuricide, to be toxic to the hemlock looper and four other western forest pests. The newest formulation, Thuricide 90-T, was shown more adaptable to aerial application than previous formulations. As a result, a large scale field test was undertaken to determine the value of the material under operational conditions. Because of the location of the study area (on an island), size of timber, and density of stands, a single rate of application was to be tested.

1/ Paper given at the national meeting of the Entomological Society of America, in St. Louis, Missouri, December 2-5, 1963.

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FIELD APPLICATION RATES. Estimating field application rates was difficult. As a result, the minimum rate was estimated from results of field tests on the gypsy moth in the Northeast in 1962 3/; it was one gallon of Thuricide plus one gallon of water per acre. Helicopter flight tests in cooperation with Agricultural Research Service personnel during May provided initial data for obtaining this rate of application. At the same time, this and two higher application rates (1 + 3, and 2 + 2) were compared as to: (1) viable spore concentrations of deposits (2) spray pattern and coverage and (3) effects of spray deposits on looper larvae placed on potted hemlocks exposed to the spray. These preliminary results were inconclusive; droplet pattern was extremely variable, washings of glass deposit plates for viable spore concentrations were non-productive and no difference was found in larval mortality on the effective swath at the three rates of application. As a result, the decision was made to use the minimum rate -- one gallon of Thuricide plus one gallon of water.

During the field test, a Bell helicopter, model G-2, equipped with a 30-foot boom and 18 #4664 T-jet spray nozzles, delivered the spray at the computed rate of 2 gallons per acre on 60-foot swaths, using a pump pressure of about 40 p.s.i. at an air speed of 30 mph. Coverage over the whole area was complete and droplet pattern was about as desired, with a m.m.d. of around 160-170 microns.

FIELD TESTING. The locale of the field test was a 325 acre tract of mature hemlock timber on Long Island in Willapa Bay, Washington. An approximately systematic arrangement of 20 3-tree plots was obtained by cutting parallel sampling lines through the undergrowth. Each plot was a sampling unit. Objectives were to: (1) relate the distribution and viability of Bacillus deposit to total looper mortality at these plots after a 20-day period (2) determine when mortality commenced, reached a peak, and ended, and (3) compare direct and indirect sampling methods for measuring the mortality. A check area was used to follow the pattern of natural mortality and deduce, if possible, effects of the spraying upon insect parasites and predators. I will report on the field sampling, and Dr. Thompson, who will present the next paper, will discuss the analysis of the Bacillus deposit.

3/ Unpublished report. Northeastern Forest Experiment Station. Forest Insect Laboratory, New Haven, Conn. Dec. 1962.

The spray application on July 19 was directed against the third larval instar. At each plot eight 5x7 inch glass slides were used to register Bacillus deposit and eight 5x7 inch cards to record spray pattern. Half were uphill, and half were downhill; all were placed in clearings. Field sampling was intensive. Numbers of loopers on plot trees were sampled 3 to 4 days before spraying and 6 times during a 20-day period after spraying, using a 35-foot aluminum pole-pruner. Under each sample tree, ground trays were placed to collect dead larvae, looper excrement, and parasite maggots; trays were examined and cleaned every other day. All living loopers were saved in alcohol to determine effect of the application on looper development. Collections for rearing insect parasites were made both during the 20-day period and a month later. Similar but less intensive studies were made in the check area. The analysis of the Bacillus deposit was made in part at a temporary field laboratory and in part at the Forestry Sciences Laboratory in Corvallis.

RESULTS. Although spray application in the test was excellent, judged by the usual standards for DDT, the control area-wise was poor. Regression analysis of looper counts on sample trees from pole-pruning showed a significant population reduction on only three plots over the 20-day post-spray period. At these plots reductions ranged from 50 to 60 percent and were only loosely related to higher deposit of the spray material. Reductions in the check area for the period averaged about 8 percent. Larvae killed by Bacillus were found in the ground trays from the 4th to the 18th day after spraying, with peak numbers the 10th day after spraying. Effects of natural control factors from the end of the 20-day period until pupation were much lower in the control area than in the check area, but there was no evidence that the spray application was responsible. Analyses to show the use of an indirect method of sampling the looper population -- frass weight -- are incomplete.

In short, one gallon of Thuricide 90-T plus one gallon of water per acre was inadequate for economic control of the western hemlock looper. It is doubtful that doubling the application would approach the level of economic control. Improvements in the material would be necessary before further testing would be profitable.